What is claimed is

1. A process of lateral crystallization comprising:

providing a silicon film on a substrate surface;

heating a localized substrate region at the substrate surface to a temperature above the formal melting point of the substrate for a short period of time such that the substrate is not significantly damaged; and

irradiating a portion of the silicon film in thermal contact with the substrate region to crystallize the portion of the silicon film using an annealing source with a fluence of less than 350 mJ/cm^2, while the localized substrate region remains above the formal melting point of the substrate.

2. A process of lateral crystallization comprising:

providing a silicon film on a substrate surface;

exposing a localized substrate region at the substrate surface to a laser heating source; and

annealing a portion of the silicon film in thermal contact with the localized substrate region by exposing the silicon film to an optical annealing source with a fluence of less than 350 mJ/cm^2.

3. The process of claim 2, wherein the substrate surface is SiO_2, and the laser heating source has an optical wavelength of between approximately 9 and 11 μm.

4. The process of claim 3, wherein the laser heating source is a CO_2 laser.

5. The process of claim 4, wherein the CO_2 laser has a pulse duration of between approximately 0.01 milliseconds and 1 millisecond.

6. The process of claim 2, wherein the optical annealing source is an excimer laser.

7. The process of claim 6, wherein the excimer laser is a XeCl laser or a KrF laser.

8. The process of claim 6, wherein the excimer laser has a pulse duration of between approximately 30 nanoseconds and 300 nanoseconds.

9. The process of claim 2, wherein the optical annealing source is a solid-state laser.

10. The process of claim 9, wherein the solid-state laser is a frequency-doubled Nd-YAG laser or a frequency-doubled Nd-YVO_4 laser.

11. The process of claim 9, wherein the solid state-laser is a frequency-tripled Nd-YAG laser or a frequency-tripled Nd-YVO_4 laser.

12. The process of claim 2, wherein the optical annealing source is a UV lamp.

13. The process of claim 12, wherein the UV lamp is a high-pressure mercury arc lamp or a high-pressure mercury-xenon arc lamp.

14. The process of claim 12, wherein the UV lamp is chopped to produce pulses less than 100 nanoseconds FWHM.

15. The process of claim 12, wherein the UV lamp is continuous.

16. The process of claim 2, wherein the optical annealing source has a fluence between about 200 mJ/cm^2 and 300 mJ/cm^2.

17. The process of claim 2, wherein the optical annealing source has a fluence between about 100 mJ/cm^2 and 200 mJ/cm^2.

18. The process of claim 2, wherein the optical annealing source has a fluence of between 130 mJ/cm^2 and 150 mJ/cm^2.

19. A process of lateral crystallization comprising:

providing a silicon film in thermal contact with a substrate;

exposing a portion of the silicon film to a continuous optical source at a fluence that is insufficient to even partially melt the silicon film by itself; and

exposing a portion of the SiO_2 layer in thermal contact with the portion of the silicon film to a CO_2 laser pulse with a duration of between approximately 0.01 milliseconds and 1 millisecond such that the exposed portion of the SiO_2 layer is heated until a substrate temperature is reached that enables the combined energy of the continuous optical source and the CO2 laser pulse to completely melt the portion of the silicon film exposed by the continuous optical source, whereby the portion of the silicon film is crystallized.

20. The process of claim 17, wherein the continuous optical source is a UV lamp.